First record of *Phylloptychoceras* (Ammonoidea) from the Maastrichtian type area, The Netherlands

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Abstract

To date, the two highest units (Nekum and Meerssen members) of the Maastricht Formation in the Maastrichtian type area (southeast Netherlands, northeast Belgium) have yielded some twenty ammonite species, the majority of which are heteromorph. Baculitids and scaphitids predominate, while diplomoceratines and nostoceratids are extremely rare and do not appear to range higher than the basal portion (subunit IVf-1) of the Meerssen Member. From subunits IVf-5 and IVf-6 of that unit as exposed at the quarries of ENCI-Heidelberg Cement Group (Maastricht) and Ankerpoort-Curfs (Geulhem), two specimens of the polyptychoceratine *Phylloptychoceras* cf. *sipho* have recently been collected, from an interval a few metres below the Cretaceous/Paleogene (K/Pg) boundary. Elsewhere in Europe, *Ph. sipho* has previously been recorded from the uppermost Maastrichtian of Denmark and the lower upper Maastrichtian of the Bay of Biscay sections (France, Spain).

Key-words: Ammonoidea, Diplomoceratidae, Polyptychoceratinae, *Phylloptychoceras*, type Maastrichtian, The Netherlands.

Résumé

Dans les deux unités supérieures (les membres Nekum et Meerssen) de la Formation de Maastricht dans la région stratotypique du Maastrichtien (sud-est des Pays-Bas, nord-est de la Belgique) une vingtaine d'espèces d'ammonites ont été récoltés, pour la plupart hétéromorphes. Les baculites et les scaphites sont nombreux mais au contraire les diplomoceratinés et les nostoceratidés sont extrêmement rares et ne paraissent ne pas dépasser la partie basale (sous-unité IVf-1du membre Meerssen). Des sous-unités IVf-5 et IVf-6 de ce membre tels qu'elles sont exposées dans les carrières ENCI-Heidelberg Cement Group (Maastricht) et Ankerpoort-Curfs (Geulhem), deux specimens du polyptychoceratiné *Phylloptychoceras* cf. *sipho* ont récemment été récoltés d'un intervalle quelques mètres en dessous de la limite Crétacé/Paléogène (K/Pg). Ailleurs en Europe *Ph. sipho* était connu du Maastrichtien terminal au Danemark et de la partie inférieure du Maastrichtien supérieur dans les coupes du Golfe de Gascogne (France et Espagne).

Mots-clefs: Ammonoidea, Diplomoceratidae, Polyptychoceratinae, *Phylloptychoceras*, Maastrichtien-type, Pays-Bas.

Introduction

Of the >20 ammonite species (Fig. 1) currently known from the two highest units of the Maastricht Formation (Nekum and Meerssen members; *Belemnitella junior* and *Belemnella* (*Neobelemnella*) *kazimiroviensis* zones; see CHRISTENSEN, 1996, 1997; CHRISTENSEN *et al.*, 2004), about three-quarters are heteromorph. Both in numbers of individuals and species, baculitids and scaphitids predominate, while other heteromorphs (nostoceratids, diplomoceratines) are extremely rare and do not appear to extend above the basal half metre or so (IVf-1) of the Meerssen Member (KENNEDY, 1987; JAGT, 2002, 2005a). Currently, the highest portion of the Meerssen Member (subunits IVf-5 and IVf-6) is well exposed at only two localities, the ENCI-Heidelberg Cement Group (Maastricht) and Ankerpoort-Curfs (Geulhem) quarries (for a detailed map and logs, see JAGT, 1999a, b). The indurated top 0.2-0.3 m of subunit IVf-5 at the former quarry has recently been yielding numerous scaphitids [mostly microconchs of *Hoploscaphites* gr. *constrictus* (J. SOWERBY, 1817)] and baculitids (*Baculites vertebralis* LAMARCK, 1801), as well as a single internal mould of *Phylloptychoceras* cf. *sipho* (FORBES, 1846).

At the Ankerpoort-Curfs quarry, the indurated top of subunit IVf-6 locally is rich in ammonites, with baculitids (*B. vertebralis* and *B. anceps* LAMARCK, 1822 in near-equal numbers) and scaphitids (*H.* gr. *constrictus* and *H.* n. sp., *sensu* KENNEDY & JAGT, 1998; see also MACHALSKI, 2005a, b) predominant, followed by the sphenodiscid *Sphenodiscus binckhorsti* J. BÖHM, 1898 and extremely rare pachydiscids [*Pachydiscus jacquoti* SEUNES, 1890, *Menuites terminus* (WARD & KENNEDY, 1993)]. The second specimen of *Ph.* cf. *sipho* is from this level.

The types of *Ph. sipho* are the best-preserved examples of the species, originally recorded from the upper Maastrichtian of Pondicherry (southern India). Material subsequently described from the Bay of Biscay sections (France, Spain), Denmark (as *Phylloptychoceras* (*Phylloptychoceras*) sp.; see BIRKELUND, 1993) and Chile (as *Phylloptychoceras* sp.; see STINNESBECK, 1986) is comparatively poorly preserved and consists mostly of

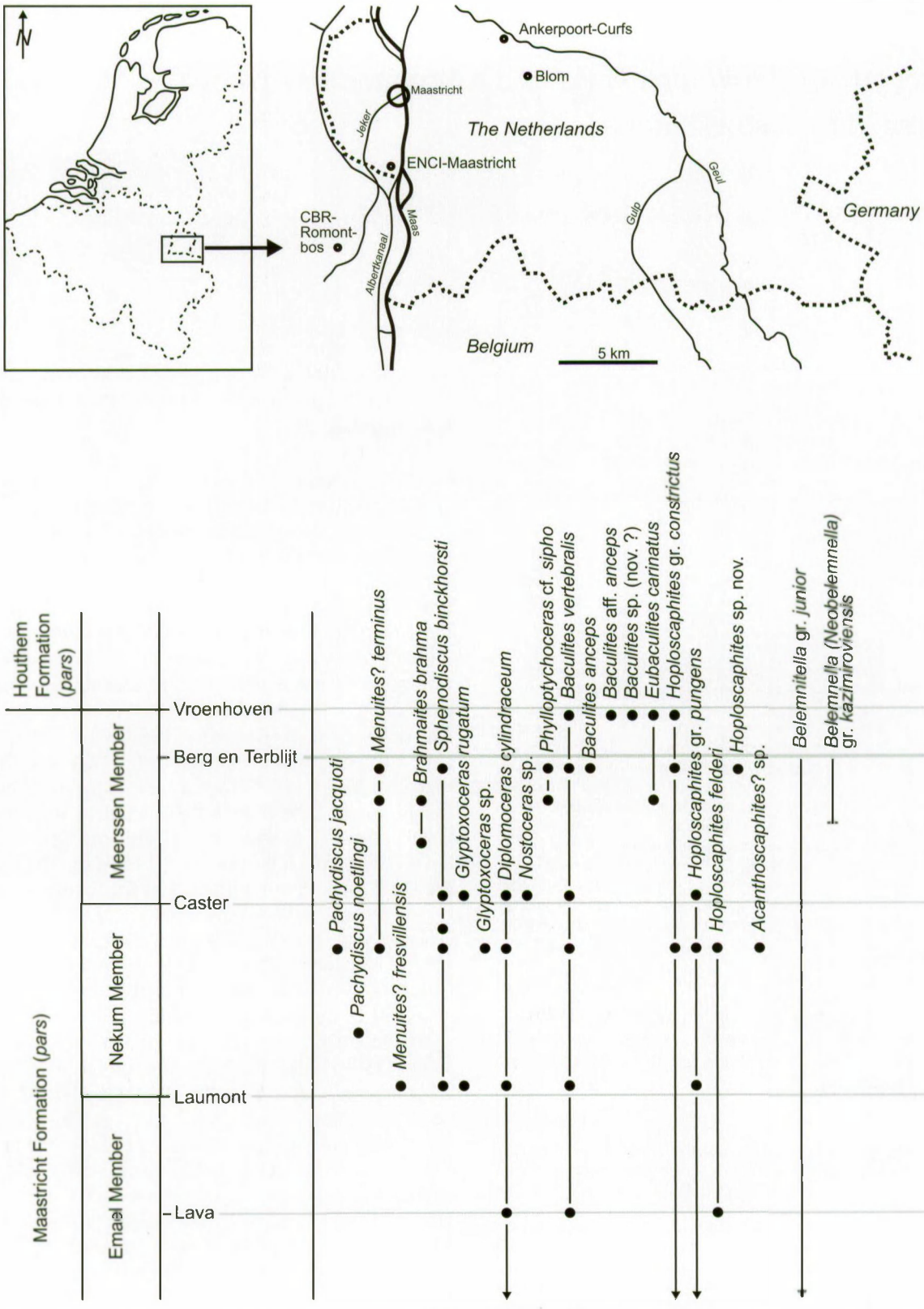

Fig. 1 — Map of southern Limburg (The Netherlands), with localities referred to in the text, plus lithostratigraphy of the upper Maastricht Formation (Emael, Nekum and Meerssen members) and lower Houthem Formation (for details: see JAGT *et al.*, 1996; FELDER & BOSCH, 1998), as exposed at the CBR-Romontbos, ENCI-Heidelberg Cement Group, Ankerpoort-Curfs and former Blom quarries (Liège, Belgium; southern Limburg, The Netherlands). Ammonite distribution as currently known (based on JAGT, 2002, 2005a, b; JAGT *et al.*, 2003, research in progress) is shown; the Cretaceous-Paleogene (K/Pg) boundary equates with the Berg en Terblijt Horizon, which forms the base of section IVf-7 (see SMIT & BRINKHUIS, 1996). Data for the Lava Horizon (Emael Member) are based exclusively on the CBR-Romontbos quarry. The ranges of *Belemnitella* gr. *junior* and *Belemnella* (*Neobelemnella*) gr. *kazimiroviensis* are also shown.

fragments of juvenile shafts and curved portions, with simplified sutures and lacking ornament. The new material from the Maastrichtian type area is better and, in addition to sutures, shows ornament well, at least in one of the specimens.

Systematic palaeontology

To denote the repositories of material referred to in the text, the following abbreviations are used: NHM – The Natural History Museum, London (formerly British Museum [Natural History]), Department of Palaeontology; NHMM – Natuurhistorisch Museum Maastricht. Suture terminology is as follows: E, external lobe; L, lateral lobe; U, umbilical lobe; I, internal lobe.

Family Diplomoceratidae SPATH, 1926
Subfamily Polyptychoceratinae MATSUMOTO, 1938
Genus *Phylloptychoceras* SPATH, 1953

TYPE SPECIES
Ptychoceras sipho FORBES, 1846, p. 118, pl. 11, fig. 5, by original designation.

REMARKS
WRIGHT *et al.* (1996) treated *Phylloptychoceras* as a subgenus of *Polyptychoceras* YABE, 1927; however, we consider the type and sole species of *Phylloptychoceras* distinct enough to warrant generic separation from *Polyptychoceras*.

Phylloptychoceras cf. ***sipho*** (FORBES, 1846)
(Pl. 1)

compare
* 1846 *Ptychoceras sipho* FORBES, p. 118, pl. 11, fig. 5.
1986 *Phylloptychoceras* sp. – STINNESBECK, p. 200, pl. 15, fig. 3; text-fig. 22.
1992b *Phylloptychoceras sipho* (FORBES, 1846) – KENNEDY & HENDERSON, p. 709, pl. 4, fig. 7; pl. 5, figs. 18-32, text-fig. 2d (with additional synonymy).
1993 *Phylloptychoceras (Phylloptychoceras)* sp. – BIRKELUND, p. 52, pl. 3, fig. 2.
1993 *Phylloptychoceras sipho* (FORBES, 1846) – WARD & KENNEDY, p. 51, figs. 18.8, 43.3, 43.4.

TYPE
Lectotype of *Ph. sipho*, designated by HOWARTH (1965, p. 386, pl. 11, fig. 1), is NHM C51153 (GSC R10504), the original of FORBES (1846, pl. 11, fig. 5a) from the Valudavur Formation of Pondicherry, southern India (see also KENNEDY & HENDERSON, 1992b, pl. 5, figs. 31, 32).

MATERIAL
NHMM 2003 206 (leg. W. Verhesen), an internal mould from subunit IVf-5, Meerssen Member (Maastricht Formation), ENCI-Heidelberg Cement Group quarry (Maastricht) and NHMM GC 3097a-c (leg. G. Cremers), an internal mould from subunit IVf-6 of the same member, Ankerpoort-Curfs quarry (Geulhem).

DESCRIPTION
NHMM 2003 206 (Pl. 1, Fig. A-C) is a fragmentary body chamber, 29 mm in length as preserved, with straight sides, a slowly expanding diameter (6.2 mm at base, 7.3 mm at upper end) and a subcircular cross section; two phragmocone chambers are preserved. However, geopetal infill on one side (ventrolaterally) and the coarse-grained nature of the matrix tend to obliterate details of the suture and ornament, and preclude measuring the whorl breadth/height ratio. From what is visible of the suture, it is seen to correspond closely to that in NHMM GC 3097a-c (see Fig. 2A). A silicone rubber cast (Pl. 1, Fig. C) prepared from the external mould does not reveal conspicuous ribbing; only under low-angle light is there a hint of low, broad ribs.

NHMM GC 3097a-c (Pl. 1, Fig. D-I) preserves three phragmocone chambers and the lower portion of the body chamber; as preserved, the latter measures 14 mm in length; it has a slowly expanding diameter (6.6 mm at base, 7.2 mm at upper end) and a subcircular cross section. Whorl breadth/height ratio is 0.97 at the base of the body chamber; ornament consists of low, broad ribs (rib index is 2), both on the phragmocone and body chamber and well visible on the external mould (Pl. 1, Fig. D, I). Figure 2A shows a composite of the suture, illustrating the mutual relationships of all composing elements, out of three succeeding right lateral sutures; the differences between these three being minor. The coarseness of the sediment obscures intricacies of incisions of the bifid lateral elements of the saddles; geopetal infill obliterates the median element of E. Nevertheless, the suture is far better preserved than in NHMM 2003 206 and is composed of fairly symmetrical triangular saddles and lobes. Saddles are bifid, with minor indentations only. U/I widest, L/U narrowest. L and U lobes have rather narrow

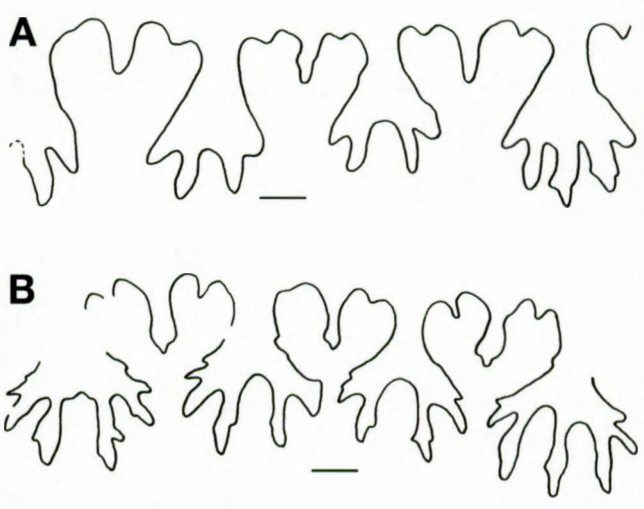

Fig. 2 — Suture lines of: A, *Phylloptychoceras* cf. *sipho*, NHMM GC 3097a; B, *P. sipho*, topotype NHM C3521a. Scale bar equals 1 mm.

necks and splayed, bifid lateral elements and a larger median element; E bifid, I trifid. E is most deeply incised, followed by I, L and U; U/I is the widest saddle, followed by E/L and L/U.

Discussion

Although both specimens represent not yet fully adult individuals, the sutures in both are of a simplified nature. Sutures of latest Cretaceous straight-shelled heteromorphs with similar simplified, bifid, triangular elements are found amongst the Polyptychoceratinae (Diplomoceratidae) and Baculitidae. Baculitids exhibiting this trifid element belong to the genus *Fresvillia* Kennedy, 1986 (see Ifrim *et al.*, 2004, text-fig.12e-g) and some enigmatic species of *Baculites*, such as *B. paradoxus* Pervinquière, 1907 (see Goolaerts *et al.*, 2004, fig. 4e, f). They are easily distinguished from the present material on account of the very reduced I. As far as polyptychoceratines are concerned, *Phylloptychoceras* appears to be the sole genus with a deeply incised, trifid I and the same style of low, broad uniform ribbing. *Phylloptychoceras* contains but a single species to date, *Ph. sipho*, known only with certainty from the type lot of the upper Maastrichtian of Pondicherry, southern India. Sutures of Forbes's type series published previously (Stoliczka, 1866; refigured in Wright *et al.*, 1996, fig. 197/6c and Kennedy & Henderson, 1992b, text-fig. 2D) do not show all of the important details. Figure 2B here shows topotype NHM C3521a and clearly documents the trifid nature of I, not seen in the suture illustrated by Kennedy & Henderson (1992b). This deeply incised trifid I is characteristic and present from the earliest stages onwards (see specimen NHM C51155). Both our material and the Indian specimens have this same deeply incised trifid I, while E, L and U are bifid.

The earliest growth stages, shown in the type lot (see Kennedy & Henderson, 1992b, pl. 5, figs. 18, 24), consist of minute, subparallel shafts in tight contact, linked by narrow curved sections and separated by a tear-shaped opening. With the exception of prorsiradiate growth lines, the shell is smooth at this stage. Larger, but otherwise comparable, fragments (see Kennedy & Henderson, 1992b, pl. 5, figs. 19, 23) have a circular cross section and show an ornament of low, broad, feebly prorsiradiate ribs plus a single constriction. We follow Kennedy & Henderson (1992b) in interpreting these as successive growth stages of *Ph. sipho*, which thus had four closely adpressed subparallel shafts, the first three and part of the fourth being septate. The lectotype is a well-preserved adult specimen, 107 mm in length, with a subcircular cross section, and consisting of a slightly curved shaft and short recurved crozier; whorl breadth/height ratio is 0.83 at mid-point of the shaft; ornament of low, broad, distant, rounded ribs; rib index 2.

Despite their fragmentary nature and mediocre preservation, sutural details and ornament in NHMM 2003 206 and NHMM GC 3097a-c show these to be close to *Ph. sipho*. Nevertheless, there remain differences between the suture of *Ph. sipho* and our material, especially in the outline of the saddles, which are definitely more phylloid-like in the type lot than in our material. We prefer, for the time being, to leave specimens from the Maastrichtian type area in open nomenclature, as *Ph.* cf. *sipho*, until more complete material is collected.

NHMM GC 3097a-c is here interpreted as a portion of the fourth shaft, showing the final phragmocone chambers and a slowly expanding body chamber with fairly prominent ornament (yet more closely spaced ribs), comparable to the lower end of the lectotype (Kennedy & Henderson, 1992b, pl. 5, figs. 31, 32). Even in the type lot, ribbing appears to be variable to some extent. NHMM 2003 206 shows closely comparable dimensions; however, it has a slowly expanding body chamber with straight sides and very faint ornament.

As noted above, generally poorly preserved polyptychoceratines have also been recorded from the Maastrichtian of Chile (Stinnesbeck, 1986, p. 200, pl. 15, fig. 3; text-fig. 22), Denmark (Birkelund, 1979, p. 56, fig. 3J; 1993, p. 52, pl. 3, fig. 2) and the Bay of Biscay sections (Ward & Kennedy, 1993, p. 51, figs. 43.3, 43.4). Most of these refer to tiny fragments of the ?first and second shaft (in comparison to the type lot), and where they do show the sutures these are closely comparable to the ones shown here, and differ in details only from the one shown by Kennedy & Henderson (1992b, text-fig. 2D).

Neocyrtochilus bryani (Anderson, 1958, p. 189, pl. 72, fig. 5) from California was considered a possible synonym of *Ph. sipho* by Kennedy (1986), but is a *nomen dubium* in our view. The type, and sole, specimen recorded to date is a small fragment with two parallel shafts connected with a hook, bearing remains of shell; suture not seen. Anderson (1958) recorded this from the Maastrichtian (see figure captions), but noted a late Campanian age in the text.

Occurrence

In Pondicherry, *Phylloptychoceras sipho* is known from the Valudavur Formation, which Kennedy & Henderson (1992a) correlated with part of the *Belemnitella junior* Zone (lower upper Maastrichtian of authors) in cephalopod terms, and with the lower part of the *Abathomphalus mayaroensis* Zone, in planktonic foraminiferal terms. In the Bay of Biscay sections (Spain, France), it is confined to Member III according to Ward & Kennedy (1993, p. 51; but see their fig. 14), while the Danish record refers to a single juvenile specimen from just below the K/Pg boundary at Stevns Klint (Sjælland). In the Maastrichtian type area, it is so far known exclusively from the uppermost Meerssen Member (subunits IVf-5 and IVf-6), of *Belemnella* (*Neobelemnella*) *kazimirovien-sis* Zone age, between 0 and 5 m below the K/Pg boundary (= Berg en Terblijt Horizon, base of subunit IVf-7; see Smit & Brinkhuis, 1996). On dinoflagellate evidence, this part of the sequence may be assigned to the *Palynodinium grallator* Zone (*Thalassiphora pelagica* Subzone), of latest Maastrichtian age, comparable to Denmark (see Brinkhuis & Schiøler, 1996; Schiøler *et al.*, 1997).

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Explanation of Plate 1

Phylloptychoceras cf. *sipho* (FORBES, 1846) from the upper Meerssen Member (Maastricht Formation) in the Maastrichtian type area; NHMM 2003 206; A, lateral view of body chamber and two phragmocone chambers; B, plan view of septum; C, lateral view of silicone rubber cast of external mould; NHMM GC 3097a-c, D, I, external mould showing ornament of body chamber; E-G, internal mould of body chamber and three phragmocone chambers; H, plan view of septum. Scale bar equals 5 mm.

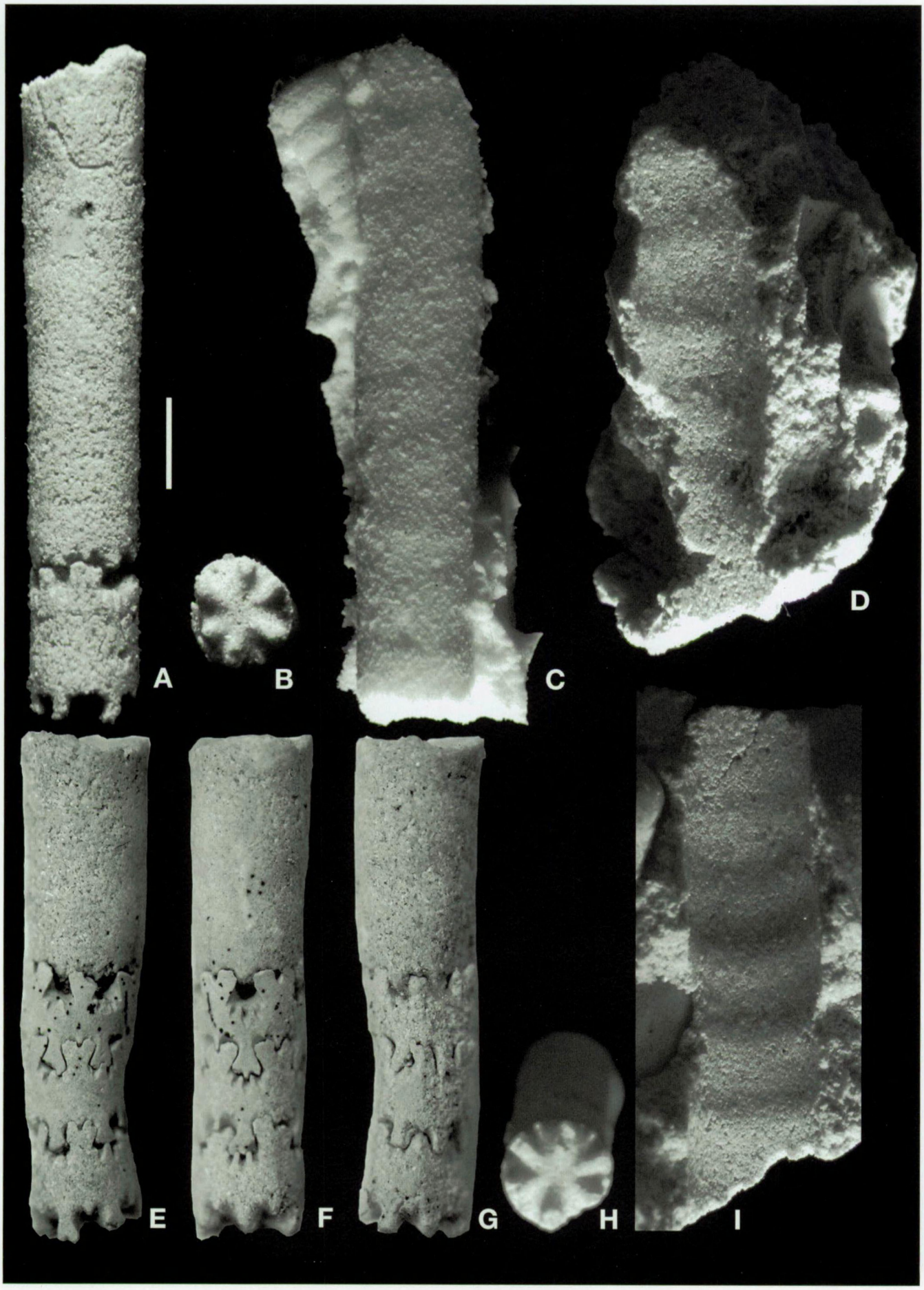

PLATE 1